



ESTEC Home Brewing Club

Rules and Operations Document

Jean-Francois Dufour

Second issue

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EHBC Rules and Operations Document: <http://tinyurl.com/Rules-and-Operations>

EHBC Webpage: www.estechomebrewingclub.com

EHBC Email address: homebrewingclub@gmail.com

Booking your Brewing Sessions: www.bookingsystem.com (Organisation ID: EHBC)

Inventory of our ingredient stock: <http://tinyurl.com/EHBC-Inventory>

Our ingredients/equipment supplier: <http://www.brouwmarkt.nl/> (in Almere)

Registration

To become a member of the EHBC Club and make use of our facilities, equipment and ingredients, take contact with the Club's Committee (see Contact) after having paid the registration fees (see account details below).

```
=====
Name: ESTEC Home Brewing Club
Account: NL24ABNA0431811342
Fee: 50EUR
Description: [Your Full Name]
=====
```

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EHBC Committee 2014

The Committee in 2014 is composed of:

Chairman:	Jean-Francois Dufour
Treasurer:	Stephane Carlier
Liaison Officer:	Martin Kaspers
Event Officer:	Jeroen Vandersteen
Engineering Officer:	Phil Blake

Club Objectives and their Implementation

Club Objectives

The Club's objectives are, with an engineering perspective,

- a) to create a community of home brewers from our pool of colleagues (creating team-building, as well as communication and learning environments),
- b) to educate about brewing techniques (through lectures, experiments, presentations from specialists),
- c) to promote interactions between home brewers, at ESTEC and also with external entities/clubs, and of course
- d) to give its members the opportunity to brew their own beers on-site with colleagues and friends.

Implementation of the objectives

To achieve these goals, the EHBC will:

- a) set up monthly brewing events at ESTEC, sometimes with an invited guest, specialized in brewing. These events are complemented with lectures, discussions and advices on brewing and the related techniques and equipment.
- b) set up a small-size home brewery at ESTEC with equipment owned by the club, which facilities will be made available to the club's members for brewing any day (the EHBC founding survey shows that the little space in Dutch houses/apartments is why many enthusiast home brewers at ESTEC can difficultly perform this activity at home - 95% of the respondents say that having the facility on-site is a prerequisite for their participation).
- c) share our hard work, passion and curiosity during external events, for example the ESTEC fun day, and to organize visits to famous breweries and to other events.

Club Equipment

Our club is equipped with one Braumeister 20 liters automatic brewing kettle and another Braumeister, 50 liters automatic brewing kettle (<http://www.speidels-braumeister.de/>).



Our top-notch brewing kettles are complemented with a complete set of brewing equipment and a temperature-controlled storage room for ideal fermentation temperature of 20°C.

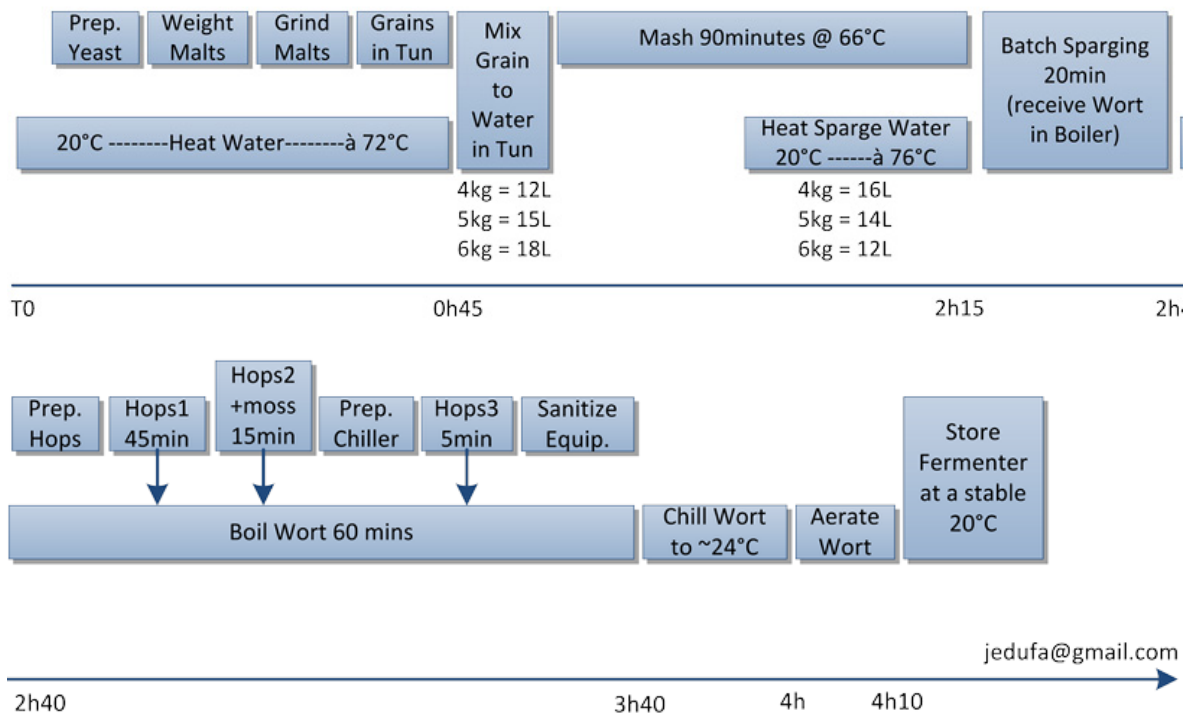


How to use the brewery

There are several guidelines to follow in order to ensure a clean, safe and fair use of the brewery:

- Do not leave your fermenting beer more than 3-4 weeks in the fermenters (fair use of facility).
- It is good practice to let your beer ferment 5-7 days in the primary fermenter, to then siphon it out to a fresh secondary fermenter in order to separate from the yeast cake (thus reducing possible off-flavors).
- Once your beer bottles are filled, bring them out immediately (we cannot store filled bottles in the facility).
- Use the booking system to reserve the equipment and visualize the bookings (see procedure below).
- You may not drink alcohol in the brewing facility.
- Every single beer brewed in the EHBC brewery shall be written down on the Craft Brew Board.
- If you have never brewed by your own before, it is wise to brew your first beer in parallel to one of our monthly brewing sessions; grab a free brew kettle and use the people around you as resource if you need support! Or ask for our short 20 minutes one-on-one tutorial sessions!

Overview of a typical home brewing process



EHBC Monthly Brewing Session Schedule 2013-2014

The EHBC will organize a monthly brewing session where one communal beer will be brewed. These sessions will sometimes host invited experienced speakers who will talk about the processes and give us some tips.

Here is the schedule of the next brewing sessions:

Thursday August 17, 2014

Thursday September 18, 2014

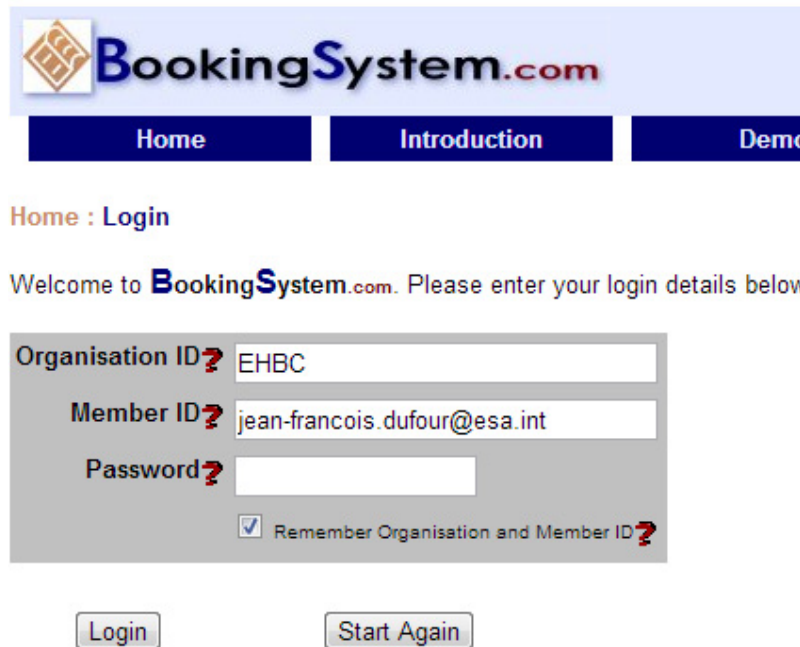
Thursday October 16, 2014

Thursday November 20, 2014

Using the Equipment for Personal Brewing

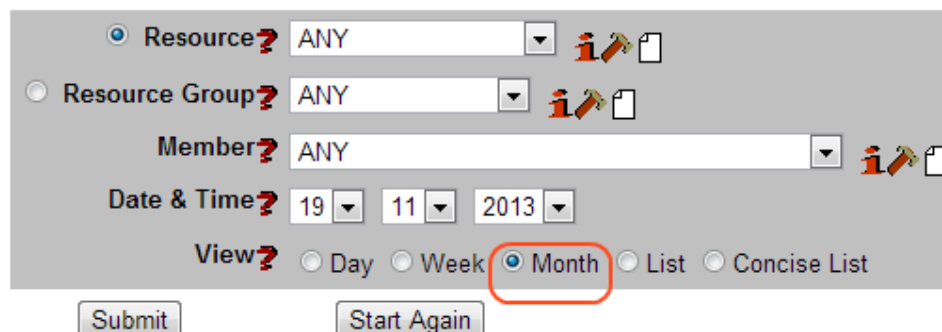
Booking Procedure

All members have been registered on our booking system (www.bookingsystem.com). You will have received an automatically-generated email (maybe check your spam folder?) with login information to this “temporary” booking system we will use until we have our own solution (months to year). This booking system will allow you to book the time slots for using the equipment. For the next few months, we will have a single brewing kettle, therefore do not book multiple bookings at the same time. Please change your password!



The screenshot shows the BookingSystem.com login interface. At the top is the logo and navigation links: Home, Introduction, and Demo. Below the navigation is a 'Home : Login' link. A welcome message states: 'Welcome to BookingSystem.com. Please enter your login details below.' The login form contains three input fields: 'Organisation ID?' with the value 'EHBC', 'Member ID?' with the value 'jean-francois.dufour@esa.int', and 'Password?'. There is a checkbox labeled 'Remember Organisation and Member ID?'. At the bottom of the form are two buttons: 'Login' and 'Start Again'.

To best view the bookings, check the "month" view to have a calendar view.



The screenshot shows the search filters section of the BookingSystem.com interface. It includes several dropdown menus: 'Resource?' set to 'ANY', 'Resource Group?' set to 'ANY', and 'Member?' set to 'ANY'. Below these is a 'Date & Time?' section with dropdowns for '19', '11', and '2013'. At the bottom is a 'View?' section with radio buttons for 'Day', 'Week', 'Month' (which is selected and circled in red), 'List', and 'Concise List'. At the bottom of the form are two buttons: 'Submit' and 'Start Again'.

Make sure to read the inventory procedure prior to book a private session!


BookingSystem.com

[Main Menu](#)
[Book A Resource](#)
[View & Edit Bookings](#)
[Lookup](#)
[Options](#)

Main Menu : View Bookings : Bookings

Showing bookings from 20/11/2013 to 19/12/2013

What do I do now?

[◀ Previous](#)
[Next ▶](#)

Mon	Tue	Wed	Thu	Fri	Sat	Sun
		20 20/11/2013	21 21/11/2013	22 22/11/2013	23 23/11/2013	24 24/11/2013
25 25/11/2013	26 26/11/2013	27 27/11/2013	28 28/11/2013 16:00 Braumeister 20L (A)	29 29/11/2013	30 30/11/2013	01 01/12/2013
02 02/12/2013	03 03/12/2013	04 04/12/2013	05 05/12/2013	06 06/12/2013 17:00 Braumeister 20L (A)	07 07/12/2013	08 08/12/2013
09 09/12/2013	10 10/12/2013	11 11/12/2013	12 12/12/2013	13 13/12/2013	14 14/12/2013	15 15/12/2013
16 16/12/2013	17 17/12/2013	18 18/12/2013	19 19/12/2013			

Follow the indicated steps to perform a booking of a resource (one of the two brewing kettles).

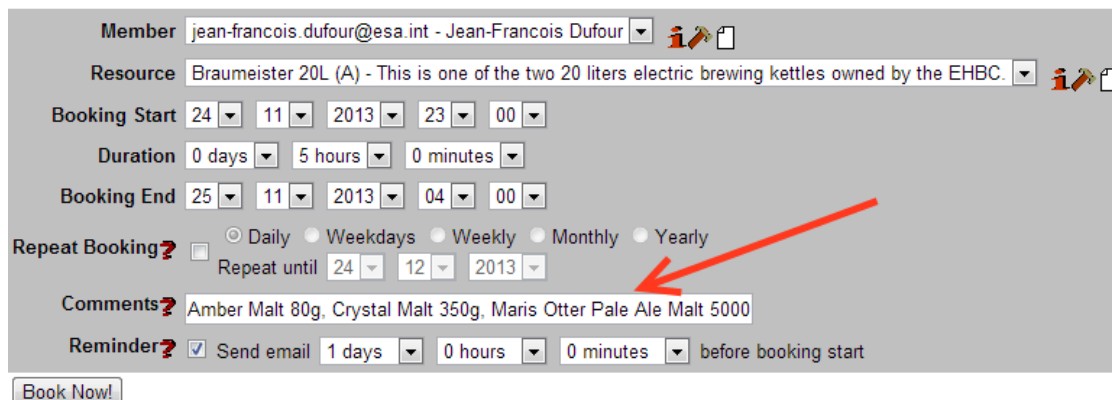
Important NOTE: When booking, add the bill of ingredients you plan on using in the comments textbox; we will update the inventory accordingly.

Inventory Procedure

How do we guarantee that you will have the necessary ingredients when you arrive to brew? We can't at the moment. Ideally we will work on a booking system that will take your ingredients bill with the current inventory and will adjust the remaining quantity accordingly. But until then we ask for the following:

- 1) When booking, add the bill of ingredients you plan on using in the comments textbox; we will update the inventory accordingly.

We receive a notification after your booking and it contains the comments.



The screenshot shows a booking form with the following fields:

- Member:** jean-francois.dufour@esa.int - Jean-Francois Dufour
- Resource:** Braumeister 20L (A) - This is one of the two 20 liters electric brewing kettles owned by the EHBC.
- Booking Start:** 24/11/2013 23:00
- Duration:** 0 days, 5 hours, 0 minutes
- Booking End:** 25/11/2013 04:00
- Repeat Booking?** ☐ ☒ Daily ☐ Weekdays ☐ Weekly ☐ Monthly ☐ Yearly
- Repeat until:** 24/12/2013
- Comments?** Amber Malt 80g, Crystal Malt 350g, Maris Otter Pale Ale Malt 5000 (indicated by a red arrow)
- Reminder?** ☒ Send email 1 days, 0 hours, 0 minutes before booking start
- Book Now!** button

Here is the spreadsheet with the ingredients we will keep:

<http://tinyurl.com/EHBC-Ingredients>

Costs for members

The EHBC will provide several ingredients to the brewer. These are:

1. Hops
2. Dry yeast
3. Specialized malts (e.g. chocolate malts, crystal malts, aroma malts, etc)
4. Base malts (e.g. pale malts, pilsner malts, ottis malts, etc)

For each personal brewing session (beer for personal usage), the Member will contribute 5 EUR for the ingredients (20 liters brew, 10EUR for 50L brew) to be transferred to the club's bank account.

Note that due to its expensive cost, liquid yeast will not be provided. Nevertheless, the EHBC will provide mason jars to harvest used yeast for a future re-utilization, meaning that if you buy liquid yeast you will be able to reuse it for a future use. We can also include your yeast wishes in our next procurement.

Unidentified mason jars with harvested yeast will be thrown away.



The Committee will assess the possibility to grow our own stock of yeast from the most popular commercial liquid yeast and store it in the club's refrigerator.

Each member has to

- provide his own bottles for bottling or
- buy the bottles from the club (40c per 333ml bottle).

Unidentified bottles lying around will be thrown away.

Short face-to-face Tutorial for Brew Kettle Utilization

We are at your disposal to take 20 minutes to show you the equipment personally and give you a crash course (15-20mins) on how to use it. Just request it and we'll dispatch someone to do that with you. We are currently working on a full brewing protocol.

We wish to give everyone this short tutorial before you brew for the first time.

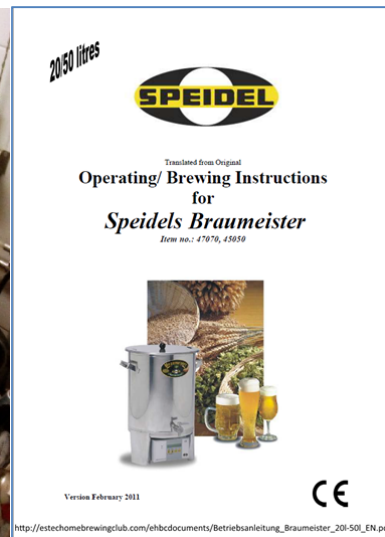
Another way is to brew in parallel to our monthly brews.

Step-by-step Brewing Procedure with the Braumeister Kettles

Preparation (20L brew)

Setup, heating water, measure ingredients, breaking grains

1. Make sure you are familiar with the user manual of the Braumeisters.



2. Install a brewing kettle on a stable table.



3. Fill the empty kettle with 23 Liters, which is 2cm below the top line of the middle steel rod.





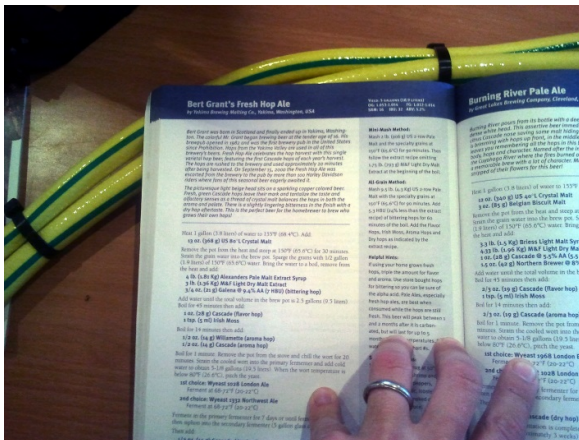
4. Insert the inner mash container red band (seal) down, with a coarse filter underneath a fine filter.



5. Plug-in the kettle and setup your mash/hops program.
 - a. Expert note: to speed up the process, add the extra 2kw plug-in heater provided. Also, you can setup the kettle in manual mode (press the two most left buttons 3 seconds) to start the heater before setting up your brewing programme; it takes approximately 25 minutes to heat the water to 65C, during that time you will have plenty of time to program your brewing profile.



6. Press START to start increasing the water temperature to the set mash phase temperature.
7. Prepare all the ingredients (e.g. you have enough of everything?).





8. Prepare the yeast if necessary (smash pack or rehydrate dry yeast in water).



9. Setup the grain crusher on a table and start crushing the grains (better hang a bucket or bag to receive the grains).



Mashing process

insert grains

Mashing brings the grain's enzymes to the right temperature to convert their starch reserves into fermentable sugars

10. Once the mash temperature is reached, slowly insert your broken grains in the middle container. Stir a bit to avoid clogging. *NOTE: make sure that the pump is not working during this step!*



11. Insert the fine filter on the center rod above the grain bed, then the coarse filter on top, then the metal bar and finally the bolt nut.



12. Confirm the current step on the machine's program to initiate the mash timer. The kettle will increase its temperature following your program. Start of the mash phase.



Post-Mash

Drain grains, fill-in extra water

13. Once the mash completed, remove the bolt nut and the metal bar, then install on the kettle top frame the "U"-shaped metal rod (will be used to hold our grain container).
14. With great care, pull up the grain middle container and install its 2 lower side pins on the "U"-shaped metal rod.



15. Confirm to the machine the readiness to start the boil.
16. Let the water contained in the wet grains drop on the grains for 10-15 minutes.
17. During this time, measure approximately the volume of wort currently in the kettle and top off with fresh water to reach again 24 Liters (or see next point for advanced method).

Note 1: If you wish, pour water at 77 degree Centigrade on the grain bed instead of filling the kettle with room-temperature water; this will retrieve all the remaining sugar from the grains.

Note 2: the boiler will evaporate approximately 3.2 liters per hour, whereas the cooling loss will equal approximately 4% (here about 0.8 liters). Three infusions of hops may absorb up to 1 liter. Starting the boil at 23L should give you 19 liters, the typical volume for home brewing recipe (5 gallons).



18. If you wish, take a gravity sample from the bottom valve of the kettle and a refractometer. Combined with the volume level of wort and a dilution online tool, you will be able to add a tailored quantity of extra water to obtain a precise original gravity (thus varying the final volume).



19. Now the right amount of water is in the kettle.

The Boil

Bring wort to a boil, insert hops additions, sanitize chiller

20. While the kettle increases the temperature of the wort to a boil, remove the drained grain container and empty it in the BIO bin outside the facility. Be careful, it is hot.



21. Wait for the boiling point; **do not leave the lid on once above 95C otherwise there will be a mess!**
22. Once the wort starts to boil, confirm the hop step in the program and drop the first hops (bitterness) to the boil. You may use hop nylon bags to reduce the quantity of particles.
23. At about 15 minutes before the end of the boil, insert the second hops (flavor hops).
24. Then, insert the wort chiller serpentine in the boiling kettle to sterilize it 15 minutes long.



- a. Or use the plate chiller instead. In this case, you need to sterilize it by soaking it in a sanitizing solution and making sure that the solution is everywhere in the chiller and in the pipes.



25. At about 5 minutes before the end of the boil, insert the last hops addition (aroma hops).



26. Connect the input of the wort chiller to the tap water pipe and its output to the water drain.

27. End of the boil.

28. If using a plate chiller, stir powerfully in a circular motion to create a whirlpool so that the hops and proteins gather in the middle of the kettle (helps clarifying the beer).

Cooling

Cool wort to 22C, sanitize fermenter

29. Start the cooling by letting the fresh water flow through the wort chiller.

Note: The first liters of water coming out of the chiller will be very hot. Try to save some of it for cleaning & sanitizing tasks later!

30. Swirl the hot wort in a circular fashion to increase the efficiency of the cooling and to centralize the many particles. The kettle will indicate the temperature at the bottom of the kettle only.

31. While waiting for the cooling process to complete, wash and sanitize a fermenter and its airlock.

32. When the temperature reaches 22 degrees Centigrade, stop the cooling process.

Finishing

Fill fermenter, add yeast, aerate wort, add identification to brew

33. Put your sanitized ferment bucket underneath the kettle's valve, open the valve and let the cooled wort flow in the fermenter from a height (as much splashing as possible!) to ensure a good level of oxygen in the wort (needed by the yeast).

34. Incline the nearly empty brewing kettle up to 90° to empty it fully from the wort.

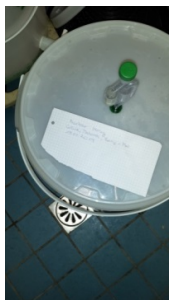
35. Sanitize the yeast pack, open it and inject the yeast in the fermenter.

36. Close the lid of the fermenter and add the airlock.

37. With a solid grip, violently shake the fermenter as long as possible (minimum 3 minutes) to again increase the oxygenation of the wort. It will create a nice healthy foam on top.

38. Fill the airlock with sanitizer solution.

39. Identify the fermenter with appropriate details and store in the fermentation room.



Cleaning

Wash kettle, clean pump, dry everything and store away

40. With soap and water, clean the kettle thoroughly and rinse properly.
41. Underneath the kettle, unscrew the pump (the whole cylinder) and clean its pieces. Reassemble the cleaned pump.
42. Dry everything and store away.
43. Clean all wet surfaces (e.g. tables, floor) and then hang cloths to dry.
44. Leave everything clean!



Step-by-step Transfer to Secondary Fermenter Procedure

1. Select an empty fermenter bucket/glass carboy, clean it, sanitize it.
2. Sanitize the auto-siphon (tube and pipe, inside and out), as well as the airlock and the rubber cap.
3. Install your (full) primary fermenter on a table and the sanitized secondary fermenter underneath.
4. With the auto-siphon pipe extremity in the secondary fermenter, insert the siphon in the primary fermenter and pump it a few times to initiate the flow down to the secondary.
5. Try not to add any oxygen to the wort during the entire process (also do not shake).
6. Once the transfer is completed, close the secondary fermenter and store.
7. With the remaining yeast cake at the bottom of the primary fermenter, you may
 - a. [Yeast is expensive]: Rinse it to harvest back the yeast for a later use (see step-by-step below) or
 - b. Dispose of the yeast cake and clean everything.



Step-by-step Yeast Rinsing Procedure (for future re-use of the yeast)

1. You have in front of you the yeast cake at the bottom of your primary fermenter.
2. Take 3 to 4 mason jars of 1.5 liters and 4 mason jars of 500ml and boil them a few minutes to kill unwanted organisms.
3. Add 3 liters of water (better have it boiled and cooled beforehand, but not critical) to the yeast cake (trub).
4. Stir the diluted trub (the trub is the layer of sediment that appears at the bottom of the fermenter after the yeast has completed the bulk of the fermentation; It is composed mainly of heavy fats, proteins and inactive yeast) energetically to have an homogeneous solution. We now need to separate the yeast from the rest of the trub.
5. Fill the 1.5 liters mason jars with the diluted trub and let rest for 15 minutes. After 15 minutes, there is a clear separation between the lighter yeast (fine white powder-like layer on top) and the rest of the heavier trub at the bottom of the jar.
6. Slowly pour the layers of yeast into 500ml mason jars, leaving as much trub behind as possible. It is OK to pour the top empty liquid too at the same time.
7. Dispose of the bad trub (what is left in the 1.5L jars).
8. Wait from 20 minutes to 2+ hours.

9. If there is again a clear separation between yeast and trub, repeat step (6). At the end of the procedure, you should have a single 500ml jar with 3cm thick yeast layer at the bottom, the rest of the space being completely filled with dark-colored water from the procedure.
10. Identify the mason jar (yeast type, date of rinsing, name) and store in refrigerator for up to 6 months.
11. When ready to reuse, it is best to reactivate the yeast by making a starter (see below for procedure).



Step-by-step Bottle Filling Procedure

1. Ensure that you have clean bottles (individual visual inspection is a good idea).
2. Fill the bottle washer with sanitizer solution (warm water + sanitizer product) and insert your caps in the solution.
3. Sanitize each bottle with the bottle washer and allow them to dry on the bottle hanger.
4. Sanitize the bottle filling tube (plastic tube with bottom valve) as well as the valve of the fermenter.
5. Once your bottles are sanitized, install your fermenter on a table and insert the bottle filling tube on the valve of the fermenter. *NOTE: if your fermenter does not have a bottom valve, you need to siphon its content into a new sanitized fermenter bucket that has one!*
6. For carbonation, add approx. 100g of dextrose sugar (for 19 liters batches) to the beer in the fermenter bucket and stir gently (not to introduce oxygen) with a sanitized spoon.
7. Take a bottle, insert the tube in the bottom to touch its bottom and initiate the flow, and fill the bottle completely. Removing the tube from the bottle will create the perfect amount of head space to store CO₂.
8. Using the crowning machine, put a cap on the bottle.

9. Repeat for all the bottles.
10. Identify the bottles right away (etiquette or writing on cap) and bring home immediately.
11. Clean and store the equipment away.

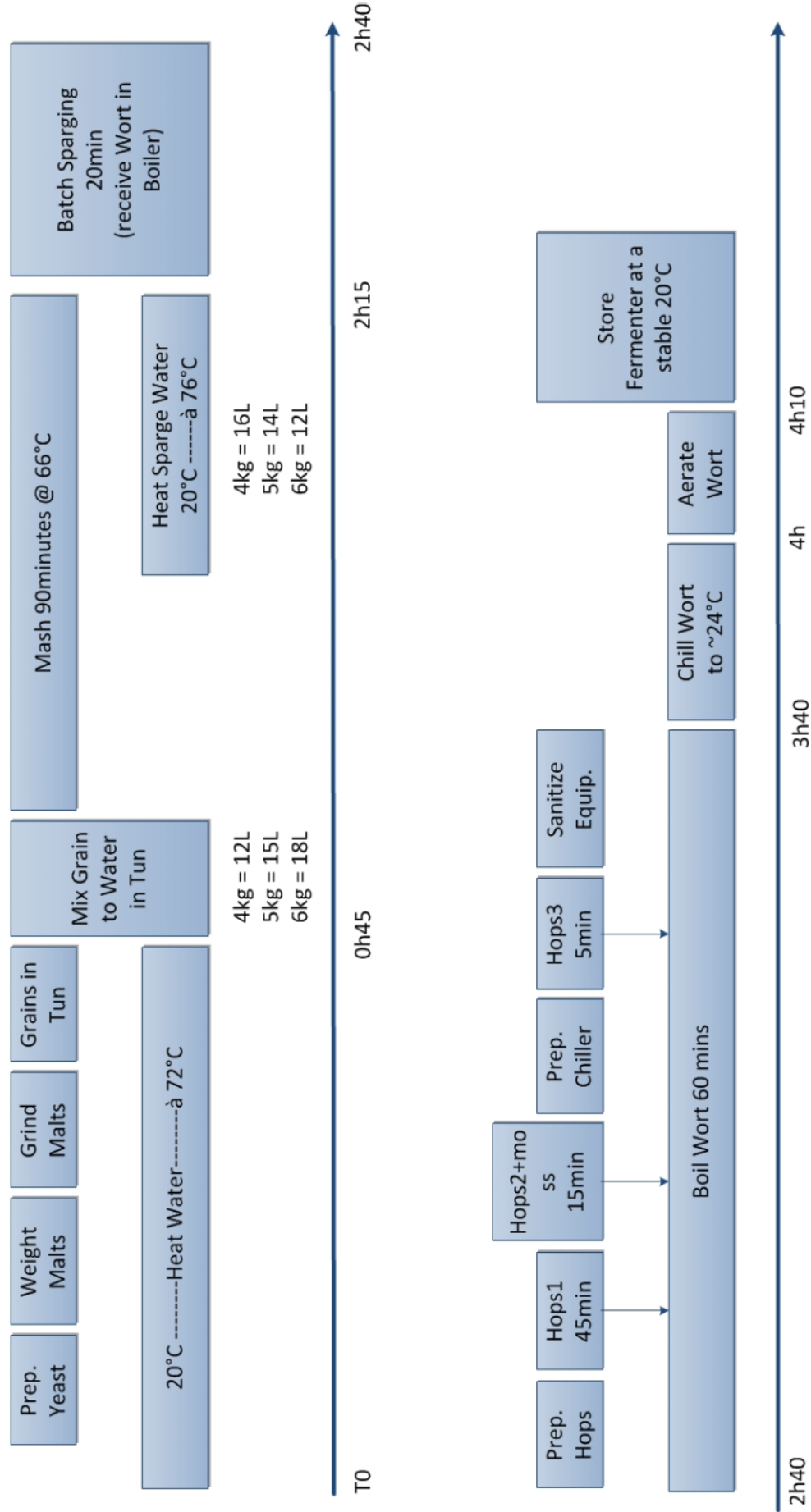


Step-by-step Making a Yeast Starter Procedure

1. For the best results, use a Erlenmeyer flask (made of heat-resistant glass).
2. Pour 200g of malt extract powder in the flask and add 1.5l of warm water.
3. Bring to boil and boil for 10 minutes (take great care when reaching the boiling point; It can make a mess!)
4. Allow to cool down to room temperature (in a bucket of water and ice will lead to faster results).
5. When cooled, pitch your yeast in the flask, shake energetically and close the flask with its rubber cap and airlock. Oxygenation of the wort is very important here.
6. Leave the wort at fermentation temperature for 1 day.
7. One day later on brew day, you may use the whole starter (2L liquid) or you may dispose of the liquid part and use only the yeast in your beer.



BREWING PROCESS



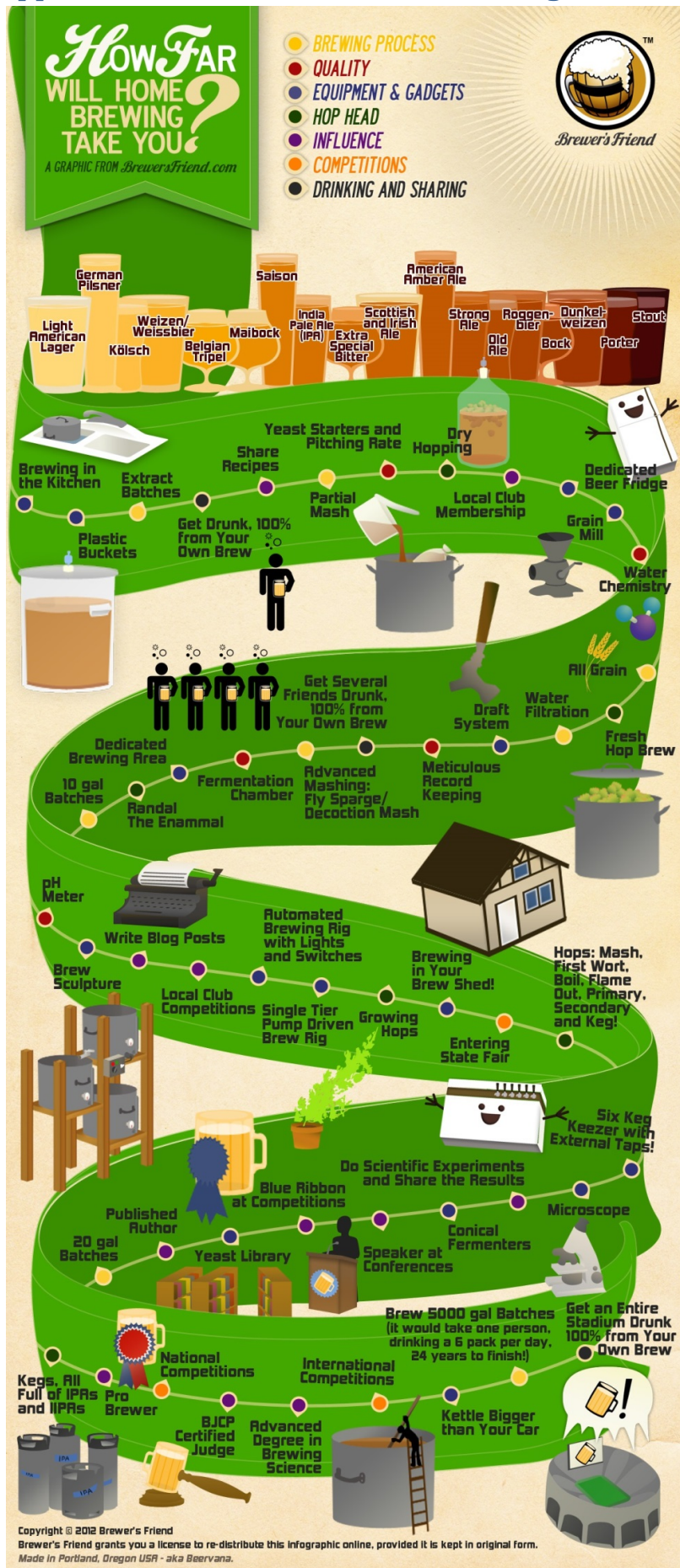
Appendix 2 – Brix Charts

Brix	O.G.
8.3	1034
8.8	1036
9.3	1038
10.0	1040
10.3	1042
10.8	1044
11.3	1046
11.7	1048
12.2	1050
12.7	1052
13.2	1054
13.6	1056
14.1	1058
14.6	1060
15.0	1062
15.5	1064
15.9	1066
16.4	1068
17.0	1070
17.3	1072
17.8	1074
18.2	1076
18.7	1078
19.1	1080
19.6	1082
20.0	1084
20.5	1086
20.9	1088
21.4	1090

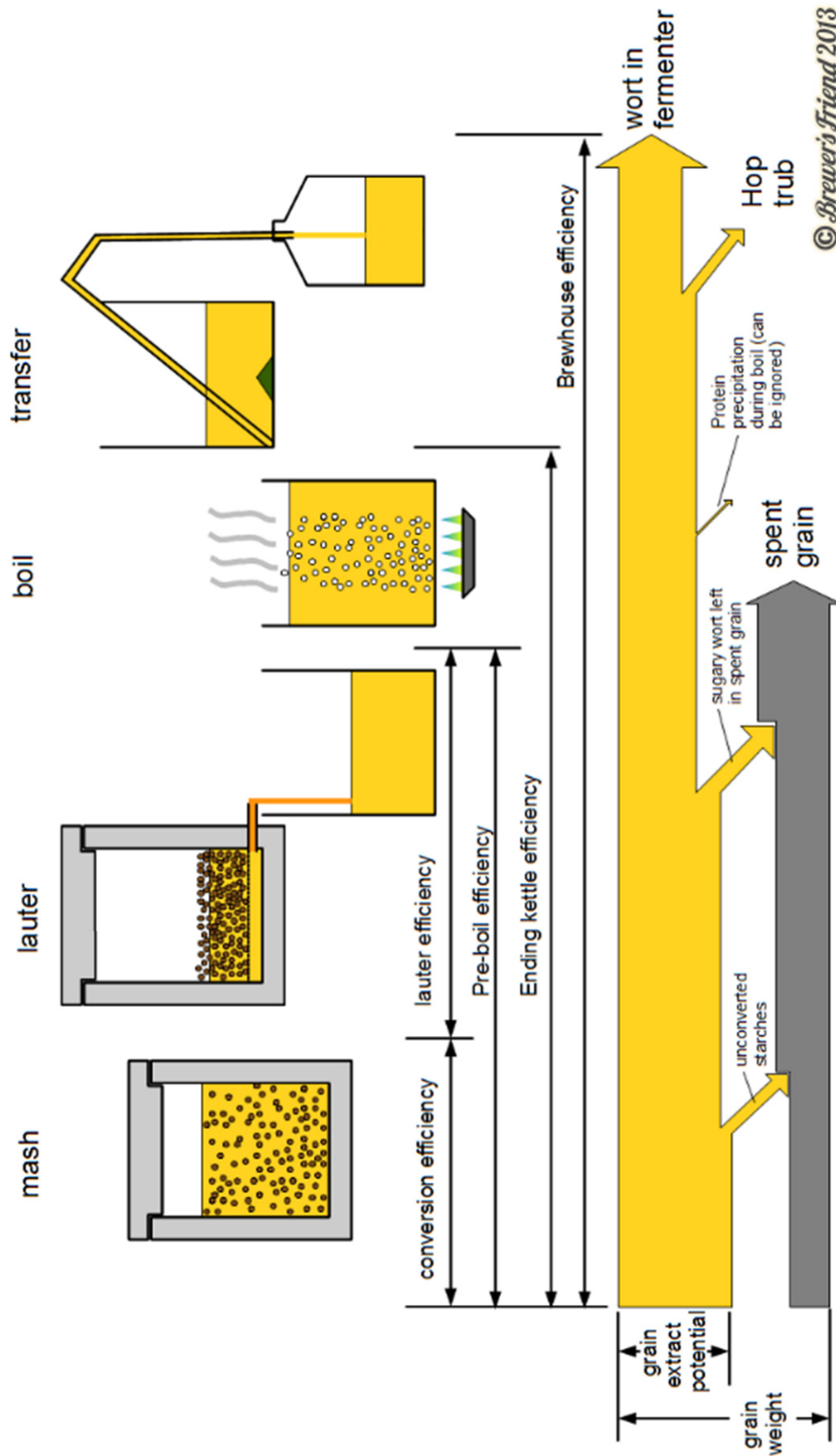
Brix to Specific Gravity during fermentation:

Calculator is here: <http://www.northernbrewer.com/refractometer-calculator/>

Appendix 3 – How Far will Home Brewing Take You



Appendix 4 - Understanding Efficiency at large



Appendix 5 – Hops Substitution Chart

name	alpha acid %	typical beer styles	possible substitutes	flavor description
Admiral (U.K.)	13.5 to 16%	Ale	U.K. Target, U.K. Northdown, U.K. Challenger	Known for its bittering potential.
Ahtanum	4 to 6.3%	Lager, American ales	Cascade, Amarillo	Floral, citrus, sharp and piney.
Amarillo	8 to 9%	Ale, IPA	Cascade, Centennial	Citrusy, flowery.
Bramling Cross (U.K.)	5 to 7%	ESB, bitter, pale ale	U.K. Kent Golding, U.K. Progress, Whitbread Goldings Variety	Quite mild, fruity currant aroma.
Bravo	14–17%	American-style IPA?		
Brewer's Gold	7 to 8.5%	English ale	Bullion	Bittering hop with neutral aroma character.
Brewer's Gold (German)	6 to 7%	Ale, heavier German-style lagers	Northdown, Northern Brewer, Galena, Bullion	Black currant, fruity, spicy.
Bullion	6.5 to 9%	IPA, ESB, stout	Columbus, Northern Brewer, German Brewer's Gold	A rich hop primarily used for bittering. Intense black currant aroma.
Cascade	4.5 to 7%	Pale ale, IPA, porter, barleywine	Centennial, Amarillo, possibly Columbus	Flowery, citrusy. Can have a grapefruit flavor.
Centennial	8 to 11.5%	All ale styles, has been used with wheat beer	Cascade, Columbus, Chinook	Medium with floral and citrus tones.
Challenger (U.K.)	6.5 to 8.5%	English-style ales, porter, stout, ESB, bitter	U.S. or German Perle, Northern Brewer	Mild to moderate, quite spicy.
Chinook	10 to 14%	Pale ale, IPA, stout, porter, lager	Nugget, Columbus, Northern Brewer, U.K. Target	Mild to medium-heavy, spicy, piney and grapefruity.
Cluster	5.5 to 8.5%	Ale and lager (good aroma for ale, good bittering for lager)	Galena	Medium and quite spicy.
Columbus	11 to 16%	IPA, pale ale, stout	Tomahawk, Zeus	Pungent.
Crystal	2 to 4.5%	Lager, pilsner, ESB	Mt. Hood, Hersbrucker, French Strisslespalt, Liberty, Hallertauer	Mild, spicy and flowery.
First Gold (U.K.)	6.5 to 8.5%	Ale, ESB	U.K. Kent Golding, maybe Crystal	A little like Golding family; spicy.
Fuggle (U.S.)	4 to 5.5%	Any English-style beer or American ale	U.K. Fuggle, Willamette, Styrian Golding, U.S. Tettnanger	Mild, woody and fruity.
Fuggle (U.K.)	4 to 5.5%	All English-style ales, ESB, bitter, lager	U.S. Fuggle, Willamette, Styrian Golding	Mild, pleasant and hoppy.
Galena	10 to 14%	Ale, porter, stout, ESB, bitter	Nugget, Pride of Ringwood, Chinook	Citrusy.
Glacier	3.3 to 9.7%	English ales, stout, porter	Willamette, U.S. Fuggles	Mild flavor, earthy aroma.
Golding (U.S.)	4 to 6%	Pale ale, ESB, all English-style beer	U.K. Golding, Whitbread Golding Variety, U.K. Progress, and possibly the Fuggle family Willamette or Fuggles	Mild, extremely pleasant and gently hoppy.
Green Bullet (New Zealand)	11 to 14%		Liberty, Ultra, Hallertauer Tradition, Crystal, Mt. Hood	Dual purpose hop.
Hallertauer (U.S.)	3.5 to 5.5%	Lager, pilsner, bock, wheat	Liberty, German Tradition, Ultra	Very mild, pleasant and slightly flowery, some spicy.
Hallertauer Gold	6 to 6.5%	Lager	U.S. Hallertauer	Known for aromatic properties similar to Hallertauer.
Hallertauer Mittelfrüh	3 to 5.5%	Lager, bock, wheat, maybe pilsner	Vanguard	Mild and pleasant.
Hallertauer Tradition (Ger.)	3.5 to 5.5%	Mild-flavored beers	Crystal, Liberty	Very fine, similar to German Hallertau Mittlefrüh.
Hersbrucker (German)	3 to 5.5%	Lager, pilsner, bock, wheat	Mt. Hood, French Strisslespalt	Mild to semi-strong, pleasant and hoppy.
Horizon	11 to 14%	Ale, lager	Magnum or a high-alpha hop	Floral and spicy.
Kent Golding (U.K.)	4 to 5.5%	All English-style ales, ESB, bitter	U.S. Golding, WGV, U.K. Progress	Gentle, fragrant, and pleasant.
Liberty	3 to 6%	Lager, pilsner, bock, wheat	Hallertauer Tradition, Hallertauer, Mt. Hood	Mild and clean aroma, slightly spicy character.
Magnum	13 to 15%	All beers, particularly lager, pilsner, stout	Northern Brewer	Good, bitter quality.
Mt. Hood	3 to 8%	Lager, pilsner, bock, wheat	Crystal, French Strisslespalt, Hersbrucker	Mild, pleasant and clean, somewhat pungent and resiny.
Newport	13–17%	any	Galena, Nugget	Fairly pungent.

name	alpha acid %	typical beer styles	possible substitutes	flavor description
Nelson Sauvin (N.Z.)	12–14%			Unique hop with grape-like character.
Northdown (U.K.)	7.5 to 9.5%	All ales, porter		Mild, pleasant, delicate aroma.
Northern Brewer (U.S.)	6 to 10%	ESB, bitter, English pale ale, porter, California (steam) beer	Nugget, Chinook	Medium-strong.
Northern Brewer (German)	7 to 10%	ESB, bitter, English pale ale, porter	Chinook, U.S. Northern Brewer	Medium-strong with some wild American tones.
Northwest Golding	4 to 5%	Ale, porter, stout, ESB, bitter		Known for aromatic properties.
Nugget	11 to 14.5%	Light lager	Columbus, Chinook, U.K. Target, Galena	Herbal.
Pacific Gem (New Zealand)	13–15%			Bittering hop with a woody character.
Palisade	5.5 to 9.5%		perhaps Cascade	some “American” characteristics.
Perle (U.S.)	6 to 9.5%	Pale ale, porter, German styles	Northern Brewer, Cluster, Galena, Chinook	Floral, slightly spicy.
Perle (German)	6 to 8.5%	Pale ale, porter, lager	U.S. Perle, Northern Brewer	Moderately intense, good and hoppy.
Phoenix (U.K.)	4.2 to 5.5%	All ales	U.K. Northdown, U.K. Kent Golding, U.K. Challenger	Similar to U.K. Challenger.
Pioneer (U.K.)	8 to 10%	Ale, ESB	U.K. Kent Golding	A mild, typical English aroma.
Polish Lublin	3 to 4.5%	Pilsner	U.S. Saaz, Czech Saaz, U.S. Tettnanger	Mild and typical of noble aroma types, spicy, herbal.
Pride of Ringwood (Australia)	7 to 10%	Australian lager	Galena, Cluster	Quite pronounced, but not unpleasant.
Progress (U.K.)	5 to 7.5%	Ale, bitter, ESB, porter	U.K. Kent Golding, Fuggle	Moderately strong, good aroma.
Saaz (Czech)	3 to 4.5%	Pilsner	U.S. Saaz, Polish Lublin	Very mild with pleasant hoppy notes.
Saaz (U.S.)	3 to 5%	Pilsner, lager, wheat	Czech Saaz, Polish Lublin	Very mild, earthy and spicy.
Santiam	5 to 7.9%	Lager, American ale, pilsner	German Tettnanger, German Spalt, German Spalt Select	Floral, slightly spicy.
Satus	12.5 to 14%		Galena	Known for its bittering and aromatic properties.
Saphir (German)	2.5–4.5%	Lagers	any noble hop	Mild aroma hop.
Simcoe	12 to 14%	hoppy American ales		A bittering and aromatic hop. Piney aroma.
Sorachi Ace (Japan)	13 to 16%			Bittering hop with lemony aroma.
Spalt (German)	4 to 5.5%	Lager	U.S. Saaz, U.S. Tettnanger, German Spalt Select	Mild and pleasant, slightly spicy.
Spalt Select (German)	4 to 6%	Lager, and any beer in which noble aroma is appropriate	U.S. Saaz, U.S. Tettnanger, German Spalt	Very fine Spalter-type aroma.
Spalt Select (U.S.)	3 to 5%	German lagers	Tettnanger, Saaz	Medium intensity and pleasant hoppy qualities. Medium-strong aroma with wild American tones.
Sterling	6 to 9%	Lager, ale, pilsner	Saaz, Polish Lublin	Herbal, spicy, pleasant aroma, hint of floral and citrus.
Strisslespalt (France)	3 to 5%	Pilsner, lager, wheat	Mt. Hood, Crystal, Hersbrucker	Medium intensity, pleasant, hoppy.
Styrian Golding (Slovenia)	4.5 to 6%	All English-style ales, ESB, bitter, lager	U.S. Fuggle, U.K. Fuggle, Willamette	Delicate, slightly spicy.
Target (U.K.)	9.5 to 12.5%	All ale and lager	Fuggle, Willamette	Pleasant English hop aroma, quite intense.
Tettnanger (U.S.)	3.4 to 5.2%	German ales and lagers, American lagers, wheat	German Spalt, Czech Saaz, Santiam	An aromatic hop, mild and slightly spicy.
Tettnanger (German)	3.5 to 5.5%	Lager, ale	German Spalt, German Spalt Select, U.S. Tettnanger, Saaz	Mild and pleasant, slightly spicy, herbal.
Tomahawk	15 to 17%	Ale	Columbus, Zeus	Primarily a bittering hop.
Tradition (German)	5 to 7%	Lager, pilsner	Hersbrucker, Hallertauer Mittelfrüh	Very fine and similar to Hallertauer Mittelfrüh.
Vanguard	4 to 5.67%		Saaz, Hallertauer Mittelfrüh	Aroma similar to continental European types.
Warrior	15 to 17%	Ale, stout	Nugget	A bittering and aromatic hop.
WGV (Whitbread Golding Variety) (U.K.)	5 to 7%	Ale	U.K. Kent Golding, U.K. Progress	Quite pleasant and hoppy, moderately intense.
Willamette	3.5 to 6%	Pale ale, ESB, bitter, English-style ale, porter, stout	U.S. Fuggle, U.S. Tettnanger, Styrian Golding	Mild and pleasant, slightly spicy, fruity, floral, a little earthy.
Yakima Cluster	6 to 8.5%			Used as a kettle hop for bittering.
Zeus	13 to 17%		Columbus, Tomahawk	Aromatic and pleasant.

Appendix 6 – Malt Chart and Characteristics

Malts Chart

[illegible]

Appendix 7 – Sugar Priming Chart, Carbonation

BYO Priming Chart For Bottle-conditioned Homebrew

The amount of carbonation in bottle-conditioned homebrew is dependent on two things — the residual level of carbon dioxide after fermentation and the amount of carbonation obtained from the priming sugar

To get the level of carbonation you desire in your homebrew, choose a level of carbonation (from Section A) and subtract the amount of residual carbonation in your beer after fermentation (from Section B). This is the amount of carbonation you to add via priming sugar. The amount of carbonation produced by three different priming agents (anhydrous glucose, glucose monohydrate and sucrose) in 5 gallons (19 L) of beer is given in Section C.

For example, let's say you fermented an American pale ale at 68 °F (20 °C) and plan to carbonate it with corn sugar (glucose monohydrate). From section A below, you decide that you want your carbonation level to be 2.4 volumes of CO₂. From section B, you see that you should have 0.85 volumes of CO₂ in your beer after fermentation at 68 °F (20 °C). Subtracting 0.85 from 2.4 gives you 1.55 volumes of CO₂, the amount of carbonation required from the priming sugar. From section C, you see that adding 4.5 oz. (128 g) yields 1.53 volumes of CO₂, which is pretty close.

Section A

Levels of Carbonation in Various Beer Styles

Style	Volume of CO ₂
American ales	2.2–3.0
British ales	1.5–2.2
German weizens	2.8–5.1
Belgian ales	2.0–4.5
European lagers	2.4–2.6
American lagers	2.5–2.8

C2.) Priming with glucose monohydrate (dextrose monohydrate)

Glucose.H ₂ O (oz.)	Glucose.H ₂ O (g)	Volumes CO ₂ /19 L
1.0	28.3	0.34
1.5	42.5	0.51
2.0	56.7	0.68
2.5	70.9	0.85
3.0	85.0	1.02
3.5	99.2	1.19
4.0	113	1.36
4.5	128	1.53
5.0	142	1.70
5.5	156	1.87
6.0	170	2.04
6.5	184	2.21
7.0	198	2.37
7.5	213	2.54
8.0	227	2.71
8.5	241	2.88
9.0	255	3.05

Section B

Residual Carbonation Left Over After Fermentation

Temperature (°F/°C)	Volumes CO ₂
47 °F (8.33 °C)	1.21
50 °F (10.0 °C)	1.15
53 °F (11.7 °C)	1.09
56 °F (13.3 °C)	1.04
59 °F (15.0 °C)	0.988
62 °F (16.7 °C)	0.940
65 °F (18.3 °C)	0.894
68 °F (20.0 °C)	0.850
71 °F (21.7 °C)	0.807
74 °F (23.3 °C)	0.767
77 °F (25.0 °C)	0.728
80 °F (26.7 °C)	0.691
83 °F (28.3 °C)	0.655

Section C

Carbonation Levels Added to 5 gallons (19 L) of Beer by Priming Sugar

C1.) Priming with anhydrous glucose (anhydrous dextrose)

Glucose (oz.)	Glucose (g)	Volumes CO ₂ /19 L
1.0	28.3	0.37
1.5	42.5	0.56
2.0	56.7	0.75
2.5	70.9	0.93
3.0	85.0	1.12
3.5	99.2	1.31
4.0	113	1.49
4.5	128	1.68
5.0	142	1.87
5.5	156	2.05
6.0	170	2.24
6.5	184	2.43
7.0	198	2.61
7.5	213	2.80
8.0	227	2.99
8.5	241	3.17
9.0	255	3.36

C3.) Priming with sucrose

Sucrose (oz.)	Sucrose (g)	Volumes CO ₂ /19 L
1.0	28.3	0.39
1.5	42.5	0.59
2.0	56.7	0.79
2.5	70.9	0.98
3.0	85.0	1.18
3.5	99.2	1.37
4.0	113	1.57
4.5	128	1.77
5.0	142	1.96
5.5	156	2.16
6.0	170	2.36
6.5	184	2.55
7.0	198	2.75
7.5	213	2.95
8.0	227	3.14
8.5	241	3.34
9.0	255	3.54

Sugar Priming Chart for Carbonation in Bottles

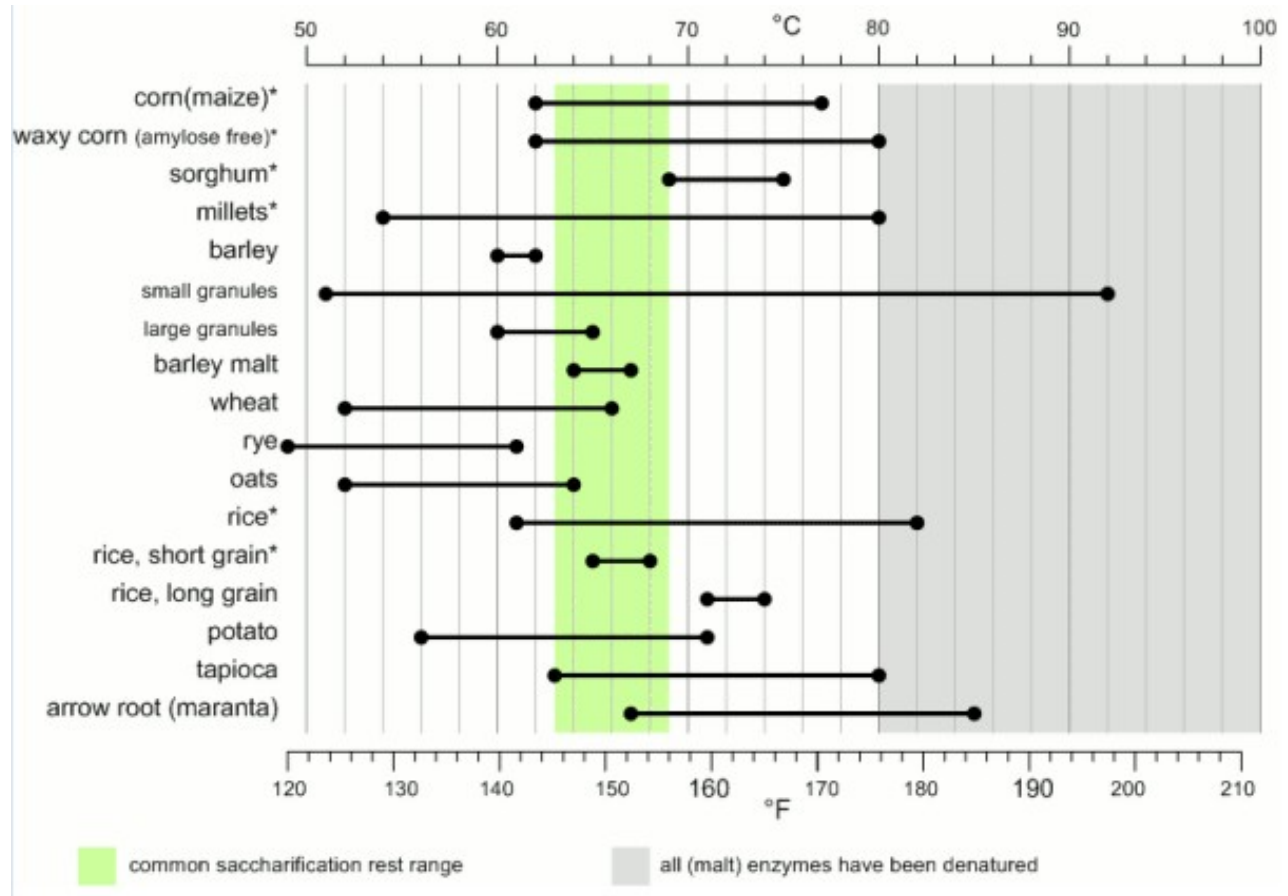
- = Extrapolated Data
- = Typical Range for Most Beer Styles

	Temperature (°C)																Pressure (bar)															
	0.01	0.13	0.2	0.27	0.34	0.41	0.48	0.55	0.62	0.69	0.76	0.83	0.9	0.96	1	1.1	1.17	1.24	1.31	1.38	1.45	1.51	1.58	1.65	1.72	1.79	1.86	1.93	2	2.07		
-1	1.82	1.92	2.03	2.14	2.23	2.36	2.48	2.60	2.70	2.82	2.93	3.02	3.13	3.24	3.35	3.46	3.57	3.67	3.78	3.89	4.00	4.11	4.22	4.33	4.44	4.55	4.66	4.77	4.87	4.98		
-0.5	1.78	1.88	2.00	2.10	2.20	2.31	2.42	2.54	2.65	2.76	2.86	2.96	3.07	3.17	3.28	3.39	3.50	3.60	3.71	3.82	3.93	4.03	4.14	4.25	4.35	4.46	4.57	4.68	4.78	4.89		
0	1.75	1.85	1.95	2.05	2.15	2.27	2.38	2.48	2.59	2.70	2.80	2.90	3.00	3.11	3.21	3.31	3.42	3.52	3.63	3.73	3.84	3.94	4.04	4.15	4.25	4.36	4.46	4.57	4.67	4.77		
0.5	1.71	1.81	1.91	2.01	2.10	2.23	2.33	2.43	2.53	2.63	2.74	2.84	2.96	3.06	3.15	3.25	3.35	3.46	3.56	3.66	3.76	3.87	3.97	4.07	4.18	4.28	4.38	4.48	4.59	4.69		
1	1.68	1.78	1.86	1.97	2.06	2.18	2.28	2.38	2.48	2.58	2.69	2.79	2.90	3.00	3.09	3.19	3.29	3.39	3.49	3.59	3.69	3.79	3.90	4.00	4.10	4.20	4.30	4.40	4.50	4.60		
1.5	1.63	1.73	1.83	1.93	2.02	2.14	2.24	2.34	2.43	2.52	2.63	2.73	2.83	2.93	3.02	3.12	3.22	3.32	3.42	3.52	3.62	3.72	3.82	3.92	4.01	4.11	4.21	4.31	4.41	4.51		
2	1.60	1.69	1.79	1.88	1.98	2.09	2.19	2.29	2.38	2.47	2.57	2.67	2.77	2.86	2.96	3.05	3.15	3.24	3.34	3.43	3.53	3.63	3.73	3.84	3.94	4.04	4.14	4.24	4.34	4.42		
2.5	1.55	1.65	1.74	1.84	1.94	2.04	2.14	2.24	2.33	2.42	2.52	2.62	2.71	2.80	2.90	3.00	3.09	3.18	3.27	3.37	3.46	3.56	3.65	3.75	3.84	3.94	4.04	4.13	4.22	4.32		
3	1.52	1.61	1.71	1.80	1.90	2.00	2.10	2.20	2.29	2.38	2.48	2.57	2.66	2.75	2.85	2.94	3.03	3.12	3.21	3.30	3.40	3.49	3.59	3.68	3.77	3.87	3.96	4.06	4.15	4.22		
3.5	1.49	1.58	1.67	1.77	1.86	1.96	2.06	2.15	2.25	2.34	2.43	2.52	2.61	2.70	2.80	2.89	2.98	3.07	3.16	3.25	3.34	3.44	3.53	3.62	3.71	3.81	3.90	3.99	4.08	4.11		
4	1.47	1.56	1.65	1.74	1.83	1.92	2.01	2.10	2.20	2.30	2.39	2.47	2.56	2.65	2.75	2.84	2.93	3.01	3.10	3.19	3.28	3.37	3.46	3.55	3.64	3.73	3.82	3.91	4.01	4.10		
5	1.43	1.52	1.61	1.70	1.79	1.88	1.97	2.06	2.16	2.25	2.34	2.43	2.52	2.60	2.70	2.79	2.88	2.96	3.05	3.14	3.23	3.32	3.41	3.50	3.59	3.68	3.77	3.86	3.95	4.04		
5.5	1.39	1.48	1.57	1.66	1.75	1.85	1.94	2.02	2.12	2.21	2.30	2.39	2.48	2.56	2.65	2.74	2.83	2.91	3.00	3.09	3.18	3.26	3.35	3.44	3.53	3.62	3.70	3.79	3.88	3.97		
6	1.37	1.46	1.54	1.63	1.72	1.81	1.90	1.99	2.08	2.17	2.26	2.34	2.43	2.52	2.61	2.69	2.78	2.86	2.95	3.04	3.13	3.21	3.30	3.39	3.47	3.56	3.65	3.74	3.82	3.91		
6.5	1.35	1.43	1.52	1.60	1.69	1.78	1.87	1.95	2.04	2.13	2.22	2.30	2.39	2.47	2.56	2.64	2.73	2.81	2.90	2.99	3.07	3.15	3.24	3.31	3.40	3.50	3.58	3.67	3.76	3.84		
7	1.32	1.41	1.49	1.58	1.66	1.75	1.84	1.91	2.00	2.08	2.17	2.26	2.34	2.42	2.51	2.60	2.69	2.77	2.86	2.94	3.02	3.11	3.19	3.28	3.36	3.45	3.53	3.62	3.70	3.79		
7.5	1.28	1.37	1.45	1.54	1.62	1.71	1.80	1.88	1.96	2.04	2.13	2.22	2.30	2.38	2.47	2.55	2.64	2.72	2.81	2.89	2.98	3.06	3.15	3.23	3.31	3.40	3.48	3.57	3.65	3.74		
8	1.26	1.34	1.42	1.51	1.59	1.68	1.76	1.84	1.92	2.00	2.09	2.18	2.26	2.34	2.42	2.50	2.59	2.67	2.76	2.84	2.93	3.02	3.09	3.18	3.26	3.35	3.43	3.51	3.60	3.68		
8.5	1.23	1.31	1.39	1.48	1.56	1.65	1.73	1.81	1.89	1.96	2.05	2.14	2.22	2.30	2.38	2.46	2.54	2.62	2.71	2.79	2.88	2.96	3.04	3.13	3.21	3.30	3.38	3.46	3.54	3.63		
9	1.21	1.29	1.37	1.45	1.53	1.62	1.70	1.79	1.86	1.95	2.01	2.10	2.18	2.25	2.34	2.42	2.50	2.58	2.67	2.75	2.83	2.91	3.00	3.07	3.15	3.23	3.31	3.39	3.47	3.56		
10	1.18	1.26	1.34	1.42	1.50	1.59	1.66	1.74	1.82	1.90	1.98	2.06	2.14	2.21	2.30	2.38	2.46	2.54	2.62	2.70	2.78	2.86	2.94	3.02	3.10	3.17	3.25	3.33	3.41	3.49		
10.5	1.18	1.26	1.34	1.42	1.49	1.57	1.64	1.71	1.79	1.87	1.95	2.02	2.10	2.18	2.26	2.34	2.42	2.49	2.57	2.65	2.74	2.82	2.90	2.97	3.05	3.13	3.19	3.27	3.34	3.42		
11	1.16	1.23	1.31	1.39	1.46	1.54	1.61	1.68	1.76	1.84	1.92	1.99	2.06	2.14	2.22	2.30	2.38	2.45	2.53	2.61	2.68	2.76	2.84	2.92	3.00	3.06	3.13	3.22	3.30	3.37		
11.6	1.14	1.21	1.29	1.36	1.44	1.51	1.59	1.66	1.74	1.81	1.89	1.96	2.03	2.10	2.18	2.26	2.34	2.41	2.49	2.57	2.64	2.71	2.79	2.86	2.94	3.01	3.09	3.16	3.24	3.31		
12	1.12	1.19	1.27	1.34	1.41	1.49	1.56	1.63	1.71	1.78	1.86	1.93	2.00	2.07	2.15	2.22	2.30	2.37	2.45	2.52	2.59	2.66	2.74	2.81	2.89	2.96	3.04	3.10	3.17	3.24		
12.7	1.10	1.17	1.24	1.31	1.39	1.46	1.53	1.60	1.68	1.75	1.82	1.89	1.97	2.04	2.12	2.18	2.26	2.33	2.40	2.47	2.54	2.62	2.69	2.76	2.83	2.89	2.97	3.04	3.11	3.18		
13	1.07	1.15	1.22	1.29	1.36	1.43	1.50	1.57	1.65	1.72	1.79	1.86	1.93	2.00	2.08	2.15	2.22	2.29	2.36	2.43	2.50	2.57	2.64	2.71	2.78	2.85	2.92	2.99	3.06	3.13		
13.8	1.05	1.12	1.19	1.26	1.33	1.40	1.47	1.54	1.62	1.70	1.77	1.83	1.90	1.97	2.04	2.11	2.18	2.25	2.32	2.39	2.46	2.53	2.60	2.67	2.73	2.80	2.87	2.94	3.00	3.08		
14	1.03	1.10	1.17	1.24	1.30	1.37	1.44	1.51	1.59	1.67	1.74	1.80	1.87	1.94	2.01	2.08	2.15	2.21	2.28	2.35	2.42	2.48	2.55	2.62	2.69	2.75	2.82	2.88	2.95	3.02		
15	1.02	1.09	1.16	1.22	1.29	1.36	1.43	1.49	1.56	1.64	1.71	1.77	1.84	1.91	1.98	2.04	2.11	2.17	2.24	2.31	2.38	2.45	2.52	2.59	2.66	2.73	2.79	2.86	2.92	2.97		
15.5	1.01	1.08	1.15	1.21	1.28	1.34	1.41	1.47	1.54	1.62	1.68	1.75	1.82	1.88	1.95	2.01	2.08	2.14	2.21	2.28	2.34	2.40	2.47	2.53	2.60	2.66	2.73	2.79	2.86	2.92		
16	0.99	1.05	1.12	1.18	1.24	1.31	1.37	1.44	1.50	1.57	1.63	1.69	1.76	1.82	1.89	1.95	2.02	2.08	2.14	2.21	2.27	2.34	2.40	2.47	2.53	2.59	2.66	2.72	2.79	2.85		
16.6	0.96	1.02	1.09	1.15	1.21	1.27	1.34	1.40	1.46	1.53	1.59	1.65	1.71	1.78	1.84	1.90	1.97	2.03	2.09	2.15	2.22	2.28	2.34	2.41	2.47	2.53	2.59	2.66	2.72	2.78		
17.2	0.93	0.99	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.49	1.55	1.61	1.67	1.73	1.79	1.85	1.92	1.98	2.04	2.10	2.16	2.22	2.28	2.35	2.41	2.47	2.53	2.59	2.65	2.71		
17.7	0.91	0.97	1.03	1.09	1.15	1.21	1.27	1.33	1.39	1.45	1.51	1.57	1.63	1.69	1.75	1.81	1.87	1.93	1.99	2.05	2.11	2.17	2.23	2.29	2.35	2.41	2.47	2.52	2.58	2.64		
18.3	0.88	0.94	1.00	1.06	1.11	1.17	1.23	1.29	1.35	1.41	1.46	1.52	1.58	1.64	1.70	1.76	1.82	1.87	1.93	1.99	2.05	2.11	2.17	2.23	2.28	2.34	2.40	2.46	2.52	2.58		
18.8	0.85	0.91	0.97	1.02	1.08	1.14	1.20	1.25	1.31	1.37	1.42	1.48	1.54	1.59	1.65	1.71	1.77	1.82	1.88	1.94	1.99	2.05	2.11	2.16	2.22	2.28	2.34	2.39	2.45	2.51		
19.4	0.83	0.88	0.94	0.99	1.05	1.10	1.16	1.22	1.27	1.33	1.38	1.44	1.49	1.55	1.60	1.66	1.72	1.77	1.83	1.88	1.94	1.99	2.05	2.10	2.16	2.22	2.27	2.33	2.38	2.44		
20	0.80	0.85	0.90	0.96	1.02	1.07	1.12	1.18	1.23	1.29	1.34	1.39	1.45	1.50	1.56	1.61	1.67	1.72	1.77	1.83	1.88	1.94	1.99	2.04	2.10	2.15	2.21	2.26	2.32	2.37		
20.5	0.77	0.83	0.88	0.93	0.98	1.04	1.09	1.14	1.19	1.25	1.30	1.35	1.40	1.46	1.51	1.56	1.62	1.67	1.72	1.77	1.83	1.88	1.93	1.98	2.04	2.09	2.14	2.20	2.25	2.30		
21	-0.10	-0.05	0.00	0.90	0.95	1.00	1.05	1.10	1.16	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.57	1.62	1.67	1.72	1.77	1.82	1.87	1.92	1.98	2.03	2.08	2.13	2.18	2.23		

Appendix 9 – Wort Dilution Chart – Ice cooling

Wort Dilution Chart																					
				Note: Ideal if you are using ice blocks to cool your wort																	
Original OG	Target Final OG	Original Volume (L)	Volume to add (L)	Original OG	Target Final OG	Original Volume (L)	Volume to add (L)	Original OG	Target Final OG	Original Volume (L)	Volume to add (L)	Original OG	Target Final OG	Original Volume (L)	Volume to add (L)	Original OG	Target Final OG	Original Volume (L)	Volume to add (L)		
1.090	1.085	14	1	1.080	1.075	14	1	1.070	1.066	14	1	1.060	1.057	14	1	1.050	1.047	14	1		
	1.080		2		1.070		2		1.062		2		1.053		2		1.044		2		
	1.075		3		1.066		3		1.059		3		1.050		3		1.042		3		
	1.071		4		1.063		4		1.056		4		1.047		4		1.039		4		
	1.067		5		1.059		5		1.052		5		1.045		5		1.037		5		
	1.063		6		1.056		6		1.050		6		1.042		6		1.035		6		
	1.085	15	1		1.075	15	1		1.066	15	1		1.057	15	1		1.047	15	1		
	1.081		2		1.071		2		1.063		2		1.054		2		1.045		2		
	1.076		3		1.067		3		1.059		3		1.051		3		1.042		3		
	1.072		4		1.064		4		1.056		4		1.048		4		1.040		4		
	1.068		5		1.060		5		1.053		5		1.046		5		1.038		5		
	1.085		1		1.075		1		1.067		1		1.057		1		1.047		1		
	1.081	16	2		1.071	16	2		1.063	16	2		1.054	16	2		1.045	16	2		
	1.077		3		1.068		3		1.060		3		1.051		3		1.043		3		
	1.073		4		1.064		4		1.057		4		1.049		4		1.040		4		
	1.068		1		1.075		1		1.067		1		1.057		1		1.048		1		
	1.082		2		1.072		2		1.064		2		1.055		2		1.045		2		
	1.078		3		1.068		3		1.061		3		1.052		3		1.043		3		
1.086	18	1	1.076	18	1	1.067	18	1	1.057	18	1	1.048	18	1							
1.082		2	1.072		2	1.064		2	1.055		2	1.045		2							
1.086		19	1.076		19	1.067		19	1.057		19	1.048		19							
1.088	1.083	14	1	1.078	1.073	14	1	1.068	1.064	14	1	1.058	1.055	14	1	1.048	1.045	14	1		
	1.078		2		1.069		2		1.060		2		1.051		2		1.043		2		
	1.074		3		1.065		3		1.057		3		1.048		3		1.040		3		
	1.070		4		1.061		4		1.054		4		1.046		4		1.038		4		
	1.066		5		1.058		5		1.051		5		1.043		5		1.036		5		
	1.062		6		1.055		6		1.048		6		1.041		6		1.034		6		
	1.083	15	1		1.073	15	1		1.064	15	1		1.055	15	1		1.045	15	1		
	1.079		2		1.069		2		1.061		2		1.052		2		1.043		2		
	1.075		3		1.066		3		1.058		3		1.049		3		1.041		3		
	1.071		4		1.062		4		1.055		4		1.046		4		1.038		4		
	1.067		5		1.059		5		1.052		5		1.044		5		1.036		5		
	1.084		1		1.073		1		1.065		1		1.055		1		1.046		1		
	1.079	16	2		1.070	16	2		1.061	16	2		1.052	16	2		1.043	16	2		
	1.075		3		1.066		3		1.058		3		1.050		3		1.041		3		
	1.072		4		1.063		4		1.055		4		1.047		4		1.039		4		
	1.068		1		1.074		1		1.065		1		1.055		1		1.046		1		
	1.080		2		1.070		2		1.062		2		1.053		2		1.043		2		
	1.076		3		1.067		3		1.059		3		1.050		3		1.041		3		
1.084	18	1	1.074	18	1	1.065	18	1	1.055	18	1	1.046	18	1							
1.080		2	1.071		2	1.062		2	1.053		2	1.044		2							
1.084		19	1.074		19	1.065		19	1.055		19	1.046		19							
1.086	1.081	14	1	1.076	1.071	14	1	1.066	1.062	14	1	1.056	1.053	14	1	1.046	1.043	14	1		
	1.076		2		1.067		2		1.059		2		1.050		2		1.041		2		
	1.072		3		1.063		3		1.055		3		1.047		3		1.038		3		
	1.068		4		1.060		4		1.052		4		1.044		4		1.036		4		
	1.064		5		1.057		5		1.049		5		1.042		5		1.034		5		
	1.060		6		1.053		6		1.047		6		1.039		6		1.032		6		
	1.081	15	1		1.071	15	1		1.062	15	1		1.053	15	1		1.043	15	1		
	1.077		2		1.068		2		1.059		2		1.050		2		1.041		2		
	1.073		3		1.064		3		1.056		3		1.047		3		1.039		3		
	1.069		4		1.061		4		1.053		4		1.045		4		1.037		4		
	1.065		5		1.058		5		1.050		5		1.042		5		1.035		5		
	1.082		1		1.072		1		1.063		1		1.053		1		1.044		1		
	1.077	16	2		1.068	16	2		1.060	16	2		1.050	16	2		1.041	16	2		
	1.073		3		1.065		3		1.057		3		1.048		3		1.039		3		
	1.070		4		1.062		4		1.054		4		1.045		4		1.037		4		
	1.062		1		1.072		1		1.063		1		1.053		1		1.044		1		
	1.078		2		1.069		2		1.060		2		1.051		2		1.042		2		
	1.074		3		1.065		3		1.057		3		1.048		3		1.040		3		
1.082	18	1	1.072	18	1	1.063	18	1	1.053	18	1	1.044	18	1							
1.078		2	1.069		2	1.060		2	1.051		2	1.042		2							
1.082		19	1.072		19	1.063		19	1.054		19	1.044		19							
1.084	1.079	14	1	1.074	1.069	14	1	1.064	1.060	14	1	1.054	1.051	14	1	1.044	1.041	14	1		
	1.075		2		1.066		2		1.057		2		1.048		2		1.039		2		
	1.070		3		1.062		3		1.054		3		1.045		3		1.037		3		
	1.066		4		1.058		4		1.051		4		1.042		4		1.035		4		
	1.063		5		1.055		5		1.048		5		1.040		5		1.033		5		
	1.059		6		1.052		6		1.045		6		1.038		6		1.031		6		
	1.079	15	1		1.070	15	1		1.061	15	1		1.051	15	1		1.042	15	1		
	1.075		2		1.066		2		1.057		2		1.048		2		1.039		2		
	1.071		3		1.063		3		1.054		3		1.046		3		1.037		3		
	1.067		4		1.059		4		1.051		4		1.043		4		1.035		4		
	1.064		5		1.056		5		1.049		5		1.041		5		1.033		5		
	1.080		1		1.070		1		1.061		1		1.051		1		1.042		1		
	1.076	16	2		1.066	16	2		1.058	16	2		1.049	16	2		1.040	16	2		
	1.072		3		1.063		3		1.055		3		1.046		3		1.038		3		
	1.068		4		1.060		4		1.052		4		1.044		4		1.036		4		
	1.080		1		1.070		1		1.061		1		1.051		1		1.042		1		
	1.076		2		1.067		2		1.058		2		1.049		2		1.040		2		
	1.073		3		1.064		3		1.055		3		1.047		3		1.038		3		
1.080	18	1	1.070	18	1	1.061	18	1	1.052	18	1	1.042	18	1							
1.077		2	1.067		2	1.058		2	1.049		2	1.040		2							
1.080		19	1.071		19	1.061		19	1.052		19	1.042		19							
1.082	1.077	14	1	1.072	1.068	14	1	1.062	1.058	14	1	1.052	1.049	14	1	1.042	1.039	14	1		
	1.073		2		1.064		2		1.055		2		1.046		2		1.037		2		
	1.069		3		1.060		3		1.052		3		1.043		3		1.035		3		
	1.065		4		1.057		4		1.049		4		1.041		4		1.033		4		
	1.061		5		1.054		5		1.046		5		1.038		5		1.031		5		
	1.058		6		1.051		6		1.044		6		1.036		6		1.030		6		
	1.078	15	1		1.068	15	1		1.059	15	1		1.049	15	1		1.040	15	1		
	1.074		2		1.064		2		1.056		2		1.046		2		1.038		2		
	1.070		3		1.061		3		1.053		3		1.044		3		1.036		3		
	1.066		4		1.058		4		1.050		4		1.041		4		1.034		4		
	1.063		5		1.055		5		1.047		5		1.039		5		1.032		5		
	1.078		1		1.068		1		1.059		1		1.049		1		1.040		1		
	1.074	16	2		1.065	16	2		1.056	16	2		1.047	16	2		1.038	16	2		
	1.070		3		1.062		3		1.053		3		1.044		3		1.036		3		
	1.067		4		1.059		4		1.050		4		1.042		4		1.034		4		
	1.078		1		1.068		1		1.059		1		1.049		1		1.040		1		
	1.082		2		1.072		2		1.056		2		1.047		2		1.038		2		
	1.071		3		1.062		3		1.054		3		1.045		3		1.036		3		
1.078	18	1	1.069	18	1	1.059	18	1	1.050	18	1	1.040	18	1							
1.075		2	1.066		2	1.057		2	1.047		2	1.038		2							
1.079		19	1.069		19	1.059		19	1.050		19	1.040		19							

Appendix 10 – Gelatinization Temperature Chart



Appendix 11 – Brew Day Checklist for All Grain Recipes



Brewer's Friend

<http://www.brewersfriend.com>

Brew Day Checklist for All Grain Recipes

Complete Recipe Builder: www.brewersfriend.com/homebrew

Brewer: _____ Brew Date: _____
Recipe Name: _____ Beer Type: _____

Setup and Mash

- ☐ Double check all ingredients are on hand for recipe, including prepared yeast starter if applicable.
- ☐ Plan out mash schedule. <http://www.brewersfriend.com/mash/>
- ☐ Begin heating strike water in hot liquor tank (HLT) or secondary kettle.
- ☐ Add brewing salts as recipe calls for or to style. <http://www.brewersfriend.com/water-chemistry/>
- ☐ Weigh out and mill grains.
- ☐ Setup mash tun and kettle and ensure they are clean.
- ☐ Make sure valves are closed on mash tun and brew kettle.
- ☐ When strike water is ready, pre-heat tun, begin dough-in procedure and mash.
- ☐ Monitor mash temperature during mash and adjust as necessary.
- ☐ Start heating water for next infusion or sprage.
- ☐ Take yeast out of fridge if using liquid ale yeast.

Sparge and Boil

- ☐ Vorlauf (drain mash tun until runnings are clear and pour back into mash tun) then drain first runnings to kettle.
- ☐ Add sparge water to mash, wait 20 minutes, then drain to kettle.
- ☐ Take a gravity reading. Pre-boil gravity: _____
- ☐ Fire the kettle and bring to a boil. Pre-boil wort collected: _____
- ☐ Stir well as hot break occurs to avoid boil over. Start timer when boil starts.

Kettle Additions - ingredients / hops as recipe calls for:

- ☐ Hops / Kettle Addition: _____ @ time _____
- ☐ Hops / Kettle Addition: _____ @ time _____
- ☐ Hops / Kettle Addition: _____ @ time _____
- ☐ Hops / Kettle Addition: _____ @ time _____
- ☐ Hops / Kettle Addition: _____ @ time _____
- ☐ With 10 minutes left, submerge wort chiller (if using immersion chiller).

Final Steps

- ☐ Sanitize lid of kettle.
- ☐ Flame out.
- ☐ Add any final hop additions or kettle ingredients.

Final Steps (continued)

- ☐ Set lid on kettle, activate wort chiller.
- ☐ Begin sanitizing primary fermenter, cork, air lock, aeration stone/hose, funnel, wine thief.
- ☐ When wort is cooled to ~70F / 21C, transfer wort into fermenter.
- ☐ Aerate wort with aeration stone (or aerate by shaking, rocking, stirring)
- ☐ Take hydrometer sample, record the value.
- ☐ Pitch yeast.
- ☐ Fit with airlock or blow off tube for high gravity or dark beers.
- ☐ Move fermenter to temperature stable area protected from light.
- ☐ Clean up equipment.

Original Gravity: _____

Wort Collected: _____

Racking – optional or as called for (usually after about 7-10 days)

- ☐ Move fermenter up to a table, let sediment settle.
- ☐ Sanitize racking cane, hose, secondary fermenter.
- ☐ Set secondary fermenter on the floor below the primary.
- ☐ Carefully rack beer into fermenter, save a sample for tasting and hydrometer sample.
- ☐ Add finings, dry hops, etc.
- ☐ Fit with airlock.

Bottling – when fermentation is complete (2-3 weeks for Ale)

- ☐ Optional – 'cold crash' for a day or two by putting fermenter into a fridge set as low as 34F (1 C).
- ☐ Determine how many and what type of bottles to use. <http://www.brewersfriend.com/bottling-calculator>
- ☐ Make sure you have enough crowns (caps) on hand.
- ☐ Move fermenter up to a table, let sediment settle.
- ☐ Begin sanitizing bottles.
- ☐ Prepare priming sugar by dissolving in warm / boiled water and let cool.
- ☐ Sanitize racking cane, hose, bottling bucket and spoon.
- ☐ Carefully rack beer into bottling bucket, save a sample for tasting and hydrometer sample.
- ☐ Add priming sugar solution, mix without splashing.
- ☐ Siphon beer into bottles.
- ☐ Cap and mark bottles.

Final Gravity: _____

Kegging – optional approach instead of bottling (easier)

- ☐ Move fermenter up to a table, let sediment settle.
- ☐ Sanitize keg.
- ☐ Rack beer straight into keg, add priming sugar or force carbonate.

Drinking your beer!

- ☐ Wait about 2 weeks and try some, note carbonation levels, flavor profile.
- ☐ Ales are ready to go in about 4-6 weeks after bottling.

Appendix 12 - Brewing Sheet



Brewer's Friend

<http://www.brewersfriend.com>

Brew Day Sheet for All Grain Beer Recipes

Brewer: _____
 Brew Date: _____
 Batch Size: _____ Boil Time: _____

Recipe Name: _____
 Beer Type: _____
 Batch #: _____ Exp. Efficiency: _____

Grains & Ingredients -

Type	Amount

Mash Schedule -

Name / Infusion Amount	Temp	Time

Mash Calculator: www.brewersfriend.com/mash

Water Mineral / pH Adjustments -

Hops -

Type	Amount	AA	Boil Time

Yeast -

Type _____
 Avg Attenuation _____
 Optimum Temperature _____
 Starter: _____

Data on yeast can be found at:

www.brewersfriend.com/yeast

Batch Vital Statistics -

Expected Original Gravity _____
 Expected Final Gravity _____
 Expected Alcohol By Volume _____
 IBUs (bitterness) _____
 SRM (color) _____
 Brew house Efficiency _____
 Carbonation Level _____

For calculators: www.brewersfriend.com/stats

Cost -

\$

Grains _____
 Hops _____
 Yeast _____
 Other _____

Total:

Hydrometer Readings - @ 60 F / 15.5 C

	Date	Gravity
Pre-Boil		
After-Boil		
Racked		
Final		

Notes -

Recipe Builder: www.brewersfriend.com/homebrew

Appendix 13 – Beer Tasting Sheet



Brewer's Friend

Beer Party Tasting Sheet

<http://www.brewersfriend.com>

Beer: _____

Appearance (10)	_____	After Taste (20)	_____
Smell (10)	_____	Drinkability (30)	_____
Taste (30)	_____	Total (100)	_____

Comments -

Beer: _____

Appearance (10)	_____	After Taste (20)	_____
Smell (10)	_____	Drinkability (30)	_____
Taste (30)	_____	Total (100)	_____

Comments -

Beer: _____

Appearance (10)	_____	After Taste (20)	_____
Smell (10)	_____	Drinkability (30)	_____
Taste (30)	_____	Total (100)	_____

Comments -

Beer: _____

Appearance (10)	_____	After Taste (20)	_____
Smell (10)	_____	Drinkability (30)	_____
Taste (30)	_____	Total (100)	_____

Comments -

Beer: _____

Appearance (10)	_____	After Taste (20)	_____
Smell (10)	_____	Drinkability (30)	_____
Taste (30)	_____	Total (100)	_____

Comments -

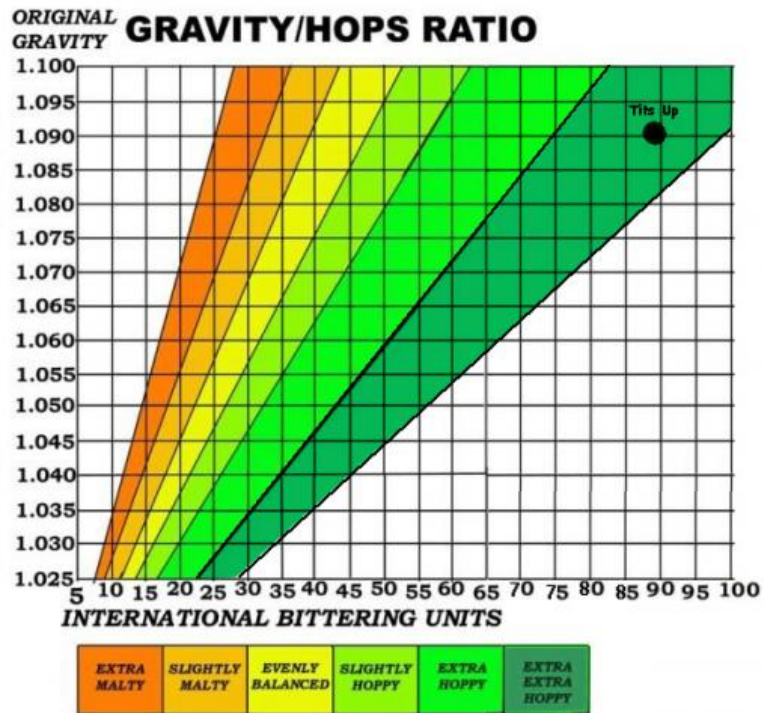
Beer: _____

Appearance (10)	_____	After Taste (20)	_____
Smell (10)	_____	Drinkability (30)	_____
Taste (30)	_____	Total (100)	_____

Comments -

Rate each beer by appearance, smell, taste, after taste, and drinkability. Then add up the total points for a maximum of 100. This beer sheet is to be used at parties with friends, so have fun with it! If the beer tastes absolutely amazing give it 30 points for taste, if you want to spit it out, give it a zero! Drinkability refers to how much the beer makes you want to have another sip. Try doing blind taste tests for even more fun!

Appendix 14 – Gravity/Hops Ratio



Appendix 15 – Types of Malts

Base Malts

Lager Malt 2 L Lager malt can be used to produce ales as well as lagers. The name comes from the fact that pale lagers are the most common style of beer and this is the malt type most commonly used to produce them. Because it tends to be the most available malt, it is used for nearly every other style also. Logically, if you intend to brew a pale lager, you would be best served by using lager malt.

After germination, lager malt is carefully heated in a kiln to 90F for the first day, withered at 120-140F for 12-20 hours and then cured at 175-185F for 4-48 hours depending on the maltster. This produces a malt with fine mild flavor and excellent enzyme potential. It is used as the basis of most of the world's beers in conjunction with specialty malts for added flavors.

Pale Ale Malt 3 L This malt type is kilned at higher temperatures than lager malt, giving a slightly toastier malt flavor well suited to Pale Ales.

Wheat Malt 3 L Wheat has been used for brewing beer nearly as long as barley and has equal diastatic power. Malted wheat is used for 5-70% of the mash depending on the style. Wheat has no outer husk and therefore has fewer tannins than barley. It is generally smaller than barley and contributes more protein to the beer, aiding in head retention. But it is much stickier than barley due to the higher protein content and may cause lautering problems if not given a "Protein Rest" during the mash.

Rye Malt 3 L Malted rye is not common but is gaining in popularity. It can be used as 5-10% of the grain bill for a rye "spicy" note. It is even stickier in the mash than wheat and should be handled accordingly.

Kilned Malts (need to be mashed)

These malts are commonly produced by increasing the curing temperatures used for base malt production, but can also be produced by toasting finished base malts for a period of time in an oven. Suggested times and temperatures for producing these types of malts at home are given in Chapter 20 - Experiment!

Biscuit Malt 25 L This fully toasted, lightly roasted malt is used to give the beer a bread and biscuits flavor. It is typically used as 10% of the total grain bill. Gives a deep amber color to the beer.

Victory Malt 25 L This roasted malt is similar in flavor to Biscuit but gives a more nutty taste to the beer. Victory adds orange highlights to the beer color.

Munich Malt 10 L This malt has an amber color and gives a very malty flavor. This malt has enough diastatic power to convert itself but is usually used in conjunction with a base malt for mashing. This malt is used for Oktoberfest-type beers and many others, including pale ales.

Vienna Malt 4 L This malt is lighter and sweeter than Munich malt and is a principal ingredient of Bock beers. Retains enough enzymatic power to convert itself but is often used with a base malt in the mash.

Dextrin Malt 3 L Also known as American Carapils, this malt is used sparingly and contributes little color but enhances the mouthfeel and perceived body of the beer. A common amount for a five gallon batch is 1/2 lb. Dextrin malt has no diastatic power. It must be mashed; if steeped it will contribute a lot of unconverted starch and cause starch haze.

Caramel Malts (may be steeped or mashed)

Caramel Malts have undergone a special heat "stewing" process after the malting which crystallizes the sugars. These sugars are caramelized into longer chains that are not converted into simple sugars by the enzymes during the mash. This results in a more malty, caramel sweet, fuller tasting beer. These malts are used for almost all ale and higher gravity lager styles. Various crystal malts are often added in half pound amounts to a total of 5-25% of the grain bill for a 5 gallon batch.

Caramel 10 10 L This malt adds a light honey-like sweetness and some body to the finished beer.

Caramel 40 40 L The additional color and light caramel sweetness of this malt is perfect for pale ales and amber lagers.

Caramel 60 60 L This is the most commonly used caramel malt, also known as medium crystal. It is well suited for pale ales, English style bitters, porters and stouts. It adds a full caramel taste and body to the beer.

Caramel 80 80 L This malt is used for making reddish colored beers and gives a lightly bittersweet caramel flavor.

Caramel 120 120 L This malt adds a lot of color and bittersweet caramel flavor. Useful in small amounts to add complexity or in greater amounts for old ales, barleywines and doppelbocks.

Special B 220 L This unique Belgian malt has a roasted nutty-sweet flavor. Used in moderation (1/4-1/2 lb.), it is very good in brown ales, porter, and doppelbocks. Larger amounts, more than a half pound in a 5 gallon batch, will lend a plum-like flavor (which may be desired in a barleywine in small amounts).

Roasted Malts (may be steeped or mashed)

These highly roasted malts contribute a coffee or burnt toast flavor to porters and stouts. Obviously these malts should be used in moderation. Some brewers recommend that they be added towards the end of the mash, claiming that this reduces the "acrid bite" that these malts can contribute. This practice does seem to produce a smoother beer for people brewing with "soft" or low bicarbonate water.

Chocolate Malt 400L Used in small amounts for brown ale and extensively in porters and stouts, this malt has a bittersweet chocolate flavor, pleasant roast character and contributes a deep ruby black color.

Black Patent Malt 580L This is the blackest of the black. It must be used sparingly, generally less than a half pound per 5 gallons. It contributes a roasted charcoal flavor that can actually be quite unpleasant if used in excess. It is useful for contributing color and/or setting a "limit" on the sweetness of other beer styles using a lot of caramel malt; one or two ounces is useful for this purpose.

Roast Barley 550L This is not actually a malt, but highly roasted plain barley. It has a dry, distinct coffee taste and is the signature flavor of Stouts. It has less of a charcoal "bite" to it than does Black Patent.